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Development Document for Proposed Effluent Limitations Guidelines and Standards for the Landfills Point Source Category

DEVELOPMENT DOCUMENT
FOR
PROPOSED EFFLUENT LIMITATIONS
GUIDELINES AND STANDARDS
FOR THE
LANDFILLS
POINT SOURCE CATEGORY

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1.0 LEGAL AUTHORITY

1.1 Legal Authority

Effluent limitations guidelines and standards for the Landfills industry are being proposed under the authority of Sections 301, 304, 306, 307, 308, and 501 of the Clean Water Act, 33 U.S.C. 1311, 1314, 1316, 1317, 1318, and 1361.

1.2 Background

1.2.1 Clean Water Act (CWA)

The Federal Water Pollution Control Act Amendments of 1972 established a comprehensive program to "restore and maintain the chemical, physical, and biological integrity of the Nation's waters" (Section 101(a)). To implement the Act, EPA is to issue effluent limitations guidelines, pretreatment standards, and new source performance standards for industrial dischargers. These guidelines and standards are summarized briefly in the following sections.

1.2.1.1 Best Practicable Control Technology Currently Available (BPT) (Section 304(b)(1) of the CWA)

In the guidelines for an industry category, EPA defines BPT effluent limits for conventional, priority,[1] and non-conventional pollutants. In specifying BPT, EPA looks at a number of factors. EPA first considers the cost of achieving effluent reductions in relation to the effluent reduction benefits. The Agency also considers: the age of the equipment and facilities; the processes employed and any required process changes; engineering aspects of the control technologies; non-water quality

[1]In the initial stages of EPA CWA regulation, EPA efforts emphasized the achievement of BPT limitations for control of the "classical" pollutants (e.g., TSS, pH, BOD_5). However, nothing on the face of the statute explicitly restricted BPT limitation to such pollutants. Following passage of the Clean Water Act of 1977 with its requirement for points sources to achieve best available technology limitations to control discharges of toxic pollutants, EPA shifted its focus to address the listed priority pollutants under the guidelines program. BPT guidelines continue to include limitations to address all pollutants.

environmental impacts (including energy requirements); and such other factors as the Agency deems appropriate (CWA 304(b)(1)(B)). Traditionally, EPA establishes BPT effluent limitations based on the average of the best performances of facilities within the industry of various ages, sizes, processes or other common characteristic. Where, however, existing performance is uniformly inadequate, EPA may require higher levels of control than currently in place in an industrial category if the Agency determines that the technology can be practically applied.

1.2.1.2 Best Conventional Pollutant Control Technology (BCT) (Section 304(b)(4) of the CWA)

The 1977 amendments to the CWA required EPA to identify effluent reduction levels for conventional pollutants associated with BCT technology for discharges from existing industrial point sources. In addition to other factors specified in Section 304(b)(4)(B), the CWA requires that EPA establish BCT limitations after consideration of a two part "cost-reasonableness" test. EPA explained its methodology for the development of BCT limitations in July 1986 (51 FR 24974).

Section 304(a)(4) designates the following as conventional pollutants: biochemical oxygen demand (BOD_5), total suspended solids (TSS), fecal coliform, pH, and any additional pollutants defined by the Administrator as conventional. The Administrator designated oil and grease as an additional conventional pollutant on July 30, 1979 (44 FR 44501).

1.2.1.3 Best Available Technology Economically Achievable (BAT) (Section 304(b)(2) of the CWA)

In general, BAT effluent limitations guidelines represent the best economically achievable performance of plants in the industrial subcategory or category. The factors considered in assessing BAT include the cost of achieving BAT effluent reductions, the age of equipment and facilities involved, the process employed, potential process changes, and non-water quality environmental impacts, including energy requirements. The Agency retains considerable discretion in assigning the weight to be accorded these factors. Unlike BPT limitations, BAT limitations may be based on effluent reductions attainable through changes in a facility's processes and operations. As with BPT,

where existing performance is uniformly inadequate, BAT may require a higher level of performance than is currently being achieved based on technology transferred from a different subcategory or category. BAT may be based upon process changes or internal controls, even when these technologies are not common industry practice.

1.2.1.4 New Source Performance Standards (NSPS) (Section 306 of the CWA)

NSPS reflect effluent reductions that are achievable based on the best available demonstrated control technology. New facilities have the opportunity to install the best and most efficient production processes and wastewater treatment technologies. As a result, NSPS should represent the most stringent controls attainable through the application of the best available control technology for all pollutants (i.e., conventional, nonconventional, and priority pollutants). In establishing NSPS, EPA is directed to take into consideration the cost of achieving the effluent reduction and any non-water quality environmental impacts and energy requirements.

1.2.1.5 Pretreatment Standards for Existing Sources (PSES) (Section 307(b) of the CWA)

PSES are designed to prevent the discharge of pollutants that pass through, interfere-with, or are otherwise incompatible with the operation of publicly-owned treatment works (POTWs). The CWA authorizes EPA to establish pretreatment standards for pollutants that pass through POTWs or interfere with treatment processes or sludge disposal methods at POTWs. Pretreatment standards are technology-based and analogous to BAT effluent limitations guidelines.

The General Pretreatment Regulations, which set forth the framework for the implementation of categorical pretreatment standards, are found at 40 CFR Part 403. Those regulations contain a definition of pass-through that addresses localized rather than national instances of pass-through and establish pretreatment standards that apply to all non-domestic dischargers (see 52 FR 1586, January 14, 1987).

1.2.1.6 Pretreatment Standards for New Sources (PSNS) (Section 307(b) of the CWA)

Like PSES, PSNS are designed to prevent the discharges of pollutants that pass through, interfere-with, or are otherwise incompatible with the operation of POTWs. PSNS are to be issued at the same time as NSPS. New indirect dischargers have the opportunity to incorporate into their plants the best available demonstrated technologies. The Agency considers the same factors in promulgating PSNS as it considers in promulgating NSPS.

1.2.2 Section 304(m) Requirements

Section 304(m) of the CWA, added by the Water Quality Act of 1987, requires EPA to establish schedules for (1) reviewing and revising existing effluent limitations guidelines and standards ("effluent guidelines") and (2) promulgating new effluent guidelines. On January 2, 1990, EPA published an Effluent Guidelines Plan (55 FR 80) that established schedules for developing new and revised effluent guidelines for several industry categories. One of the industries for which the Agency established a schedule was the Centralized Waste Treatment industry.

The Natural Resources Defense Council (NRDC) and Public Citizen, Inc. filed suit against the Agency, alleging violation of Section 304(m) and other statutory authorities requiring promulgation of effluent guidelines (NRDC et al. v. Reilly, Civ. No. 89-2980 (D.D.C.)). Under the terms of a consent decree dated January 31, 1992, which settled the litigation, EPA agreed, among other things, to propose effluent guidelines for the "Landfills and Industrial Waste Combusters" category[2] by December 1995 and take final action on these effluent guidelines by December 1997. On February 4, 1997, the court approved modifications to the Decree which revise the deadlines to November 1997 for proposal and November 1999 for final action. EPA provided notice of these modifications on February 26, 1997, at 62 FR 8726. Although the Consent Decree lists "Landfills and Industrial

[2] In the 1990 304(m) plan and the 1992 Decree, the category name was "Hazardous Waste Treatment, Phase II", subsequently renamed as "Landfills and Industrial Waste Combusters."

Waste Combusters" as a single entry, EPA is publishing separate rulemaking proposals for Industrial Waste Combusters and for Landfills.

2.0 SUMMARY AND SCOPE

2.1 Introduction

The proposed regulations for the Landfills industry include effluent limitations guidelines and standards for the control of wastewater pollutants. This document presents the information and rationale supporting these proposed effluent limitations guidelines and standards. Section 2.2 presents the proposed subcategorization approach, Section 2.3 describes the scope of the proposed regulations, and Section 2.4 through 2.9 summarizes the proposed effluent limitations and standards.

2.2 Subcategorization

EPA is proposing to subcategorize the landfills category according to the landfill classifications established under the Resource Conservation and Recovery Act (RCRA). These subcategories are summarized below:

Subcategory I: Subtitle D Non-Hazardous Landfills

Subcategory I would apply to wastewater discharges from all landfills classified as RCRA Subtitle D non-hazardous landfills subject to either of the criteria established in 40 CFR Parts 257 (Criteria for Classification of Solid Waste Disposal Facilities and Practices) or 258 (Criteria for Municipal Solid Waste Landfills).

Subcategory II: Subtitle C Hazardous Landfills

Subcategory II would apply to wastewater discharges from a solid waste disposal facility subject to the criteria in 40 CFR 264 Subpart N - Standards for Owners and Operators of Hazardous Waste Treatment, Storage, and Disposal Facilities and 40 CFR 265 Subpart N - Interim Standards for Owners and Operators of Hazardous Waste Treatment, Storage, and Disposal Facilities.

2.3 Scope of Proposed Regulation

EPA is proposing effluent limitations guidelines and pretreatment standards for wastewater discharges associated only with the operation and maintenance of landfills regulated under Subtitles C and D of the Resource Conservation and Recovery Act. EPA's proposal would not apply to wastewater discharges associated with the operation and maintenance of land application or treatment units, surface impoundments, underground injection wells, waste piles, salt dome or bed formations, underground mines, caves or corrective action units. Additionally, this guideline would not apply to waste transfer stations, or any wastewater not directly attributed to the operation and maintenance of Subtitle C or Subtitle D landfill units. Consequently, wastewaters such as those generated in off-site washing of vehicles used in landfill operations are not within the scope of this guideline.

The wastewater flows which are covered by the rule include leachate, gas collection condensate, drained free liquids, laboratory-derived wastewater, contaminated storm water and contact washwater from truck exteriors and surface areas which have come in direct contact with solid waste at the landfill facility. Groundwater, however, which has been contaminated by a landfill and is collected, treated, and discharged is excluded from this guideline.

EPA is proposing to exclude landfills operated in conjunction with other industrial or commercial operations which only receive waste generated on site (captive facility) and/or receive waste from off-site facilities under the same corporate structure (intra-company facility), so long as the wastewater is commingled for treatment with other non-landfill process wastewaters. A landfill which accepts off-site waste from a company not under the same ownership as the landfill would not be considered a captive or intracompany facility and would be subject to the landfills category effluent guideline when promulgated.

2.4 Best Practicable Control Technology Currently Available (BPT)

EPA is proposing to establish BPT effluent limitations guidelines for conventional, priority, and non-conventional pollutants for both subcategories. For RCRA Subtitle D non-hazardous waste landfills, EPA proposes to establish effluent limitations standards based on equalization, biological treatment, and multimedia filtration. For RCRA Subtitle C hazardous waste landfills, EPA proposes to establish effluent limitations standards based on equalization, chemical precipitation, and biological treatment.

2.5 Best Conventional Pollutant Control Technology (BCT)

EPA is proposing to establish BCT effluent limitations guidelines equivalent to the BPT guidelines for the control of conventional pollutants for both subcategories.

2.6 Best Available Technology Economically Achievable (BAT)

EPA is proposing to establish BAT effluent limitations guidelines equivalent to the BPT guidelines for control of priority and non-conventional pollutants for both subcategories.

2.7 New Source Performance Standards (NSPS)

EPA is proposing to establish NSPS effluent limitations guidelines equivalent to the BPT, BCT, and BAT guidelines for the control of conventional, priority and non-conventional pollutants for both subcategories.

2.8 Pretreatment Standards for Existing Sources (PSES)

EPA is proposing to establish PSES standards for priority and non-conventional pollutants for Subtitle C hazardous landfills only. EPA is proposing to establish PSES standards based on equalization, chemical precipitation, and biological treatment. EPA is not proposing to establish PSES standards for Subtitle D non-hazardous landfills.

2.9 Pretreatment Standards for New Sources (PSNS)

EPA is proposing to establish PSNS effluent limitations guidelines equivalent to PSES guidelines for the control of priority and non-conventional pollutants for Subtitle C hazardous landfills. EPA is not proposing to establish PSNS for Subtitle D non-hazardous landfills.

Table 2-1: Proposed Concentration Limitations for Hazardous Landfill Subcategory, Direct Discharges

Pollutant or Pollutant Property	Maximum for 1 day (mg/l)	Monthly average shall not exceed (mg/l)
BOD_5	160	40
TSS	89	27
Ammonia	5.9	2.5
Arsenic	1.0	0.52
Chromium (Total)	0.86	0.40
Zinc	0.37	0.21
Alpha Terpineol	0.042	0.019
Aniline	0.024	0.015
Benzene	0.14	0.036
Benzoic Acid	0.12	0.073
Naphthalene	0.059	0.022
P-Cresol	0.024	0.015
Phenol	0.048	0.029
Pyridine	0.072	0.025
Toluene	0.080	0.026
pH	Shall be in the range 6.0 - 9.0 pH units.	

Table 2-2: Proposed Concentration Limitations for Hazardous Landfill Subcategory, Indirect Discharges

Pollutant or Pollutant Property	Maximum for 1 day (mg/l)	Monthly average shall not exceed (mg/l)
Ammonia	5.9	2.5
Alpha Terpineol	0.042	0.019
Aniline	0.024	0.015
Benzoic Acid	0.12	0.073
P-Cresol	0.024	0.015
Toluene	0.080	0.026

Table 2-3: Proposed Concentration Limitations for Non-Hazardous Landfill Subcategory, Direct Discharges

Pollutant or Pollutant Property	Maximum for 1 day (mg/l)	Monthly average shall not exceed (mg/l)
BOD_5	160	40
TSS	89	27
Ammonia	5.9	2.5
Zinc	0.20	0.11
Alpha Terpineol	0.059	0.029
Benzoic Acid	0.23	0.13
P-Cresol	0.046	0.026
Phenol	0.045	0.026
Toluene	0.080	0.026
pH	Shall be in the range 6.0 - 9.0 pH units.	

3.0 INDUSTRY DESCRIPTION

The Landfills industry consists of facilities that receive wastes either as commercial or municipal operations, or as on-site (captive) operations owned by waste generators, and discharge wastewater to surface waters and/or Publicly Owned Treatment Works (POTWs) as a result of these operations. The Resource Conservation and Recovery Act (RCRA) defines a landfill as "an area of land or an excavation in which wastes are placed for permanent disposal, and that is not a land application unit, surface impoundment, injection well, or waste pile" (40 CFR 257.2). RCRA classifies landfills as either Subtitle C hazardous or Subtitle D non-hazardous. Wastewaters generated and discharged by landfills can include leachate, gas collection condensate, contaminated groundwater, contaminated storm water, drained free liquids, truck/equipment washwater, laboratory-derived wastewater, and wastewaters recovered from pump wells.

Landfills are commonly classified by the types of wastes they accept and/or by their ownership status. Some of the terms used to describe a landfill include municipal, sanitary, chemical, industrial, RCRA, hazardous waste, Subtitle C, and Subtitle D. Although non-hazardous landfills do not knowingly accept hazardous wastes, these facilities may contain hazardous wastes due to disposal practices that occurred prior to 1980 and the enactment of RCRA and its associated regulations. The following section includes definitions of the various types of landfills, landfill operations, and the wastes processed in each:

Ownership Status

- ***Municipal:*** Municipally owned landfills are those that are owned by local governments. Municipally owned landfills may be designed to accept either Subtitle D or Subtitle C wastes (see "Regulatory Type").

- ***Commercial:*** Commercial landfills are privately owned facilities and can be designed to receive either municipal, hazardous, or non-hazardous industrial wastes. Typical non-hazardous industrial wastes include packaging and shipping materials, construction and demolition debris, ash, and sludge.

- ***Captive:*** Captive sites are landfill facilities operated in conjunction with other industrial or commercial operations which only receive waste generated on-site. Captive landfills are located on, or adjacent to, the facility they service and are common at major hazardous waste generators, such as chemical and petrochemical manufacturing plants.

- ***Intra-company:*** Landfill facilities operated in conjunction with other industrial or commercial operations which only receive waste from off-site facilities under the same corporate structure, ownership, or control. These landfills are similar to captive sites but are used to receive wastes from multiple locations of one company.

Regulatory Type

- ***Subtitle C:*** Subtitle C landfills are those disposal operations authorized by RCRA to accept hazardous wastes as defined in 40 CFR Part 261. Subtitle C hazardous landfills are subject to the criteria in 40 CFR Subpart N (Standards for Owners and Operators of Hazardous Waste Treatment, Storage, and Disposal Facilities). More details on the regulatory requirements of Subtitle C are presented in Section 3.1

- ***Subtitle D:*** Subtitle D landfills are those disposal operations that are authorized by RCRA to receive municipal, commercial, or industrial wastes not defined as hazardous or which are excluded from regulation under Subtitle C, as defined in 40 CFR Parts 257 and 258. The wastes received at Subtitle D landfills include municipal refuse, ash, sludge, construction and demolition debris, and non-hazardous industrial waste. These facilities were not designed to receive hazardous wastes; however, prior to 1980 and the enactment of RCRA, older landfills may have received waste later classified as hazardous under RCRA. Any Subtitle D landfill accepting municipal refuse after October 9, 1993 is classified as a Municipal Waste Disposal Unit, and is regulated under 40 CFR 258. Any Subtitle D landfill not accepting municipal waste after October 9, 1993 continues to be regulated under 40 CFR 257. For the purposes of this document, Subtitle D landfills not accepting municipal refuse are referred to as "Subtitle D non-municipal" landfills.

The following discussions present a regulatory history of this industry and past EPA studies.

3.1 Regulatory History of the Landfills Industry

Depending on the type of wastes disposed of at a landfill, the landfill may be subject to regulation and permitting under either Subtitle C or Subtitle D of the Resource Conservation and Recovery Act (RCRA). Subtitle C facilities receive wastes that are identified or listed as hazardous wastes under EPA regulations. Subtitle D landfills can accept wastes that are not required to be sent to Subtitle C facilities. The following sections outline some of the key regulations that have been developed to control the environmental impacts of Subtitle C and Subtitle D landfills.

3.1.1 RCRA Subtitle C

Subtitle C of the RCRA of 1976 directed EPA to promulgate regulations to protect human health and the environment from the improper management of hazardous wastes. Based on this statutory mandate, the goal of the RCRA program was to provide comprehensive, "cradle-to-grave" management of hazardous waste. These regulations establish a system for tracking the disposal of hazardous wastes and special design requirements for landfills depending on whether a landfill accepted hazardous or non-hazardous waste. Key statutory provisions in RCRA Subtitle C include:

- Section 3001: Requires the promulgation of regulations identifying the characteristics of hazardous waste and listing particular hazardous wastes.
- Section 3002: Requires the promulgation of standards, such as manifesting, record keeping, etc., applicable to generators of hazardous waste.
- Section 3003: Requires the promulgation of standards, such as manifesting, record keeping, etc., applicable to transporters of hazardous waste.
- Section 3004: Requires the promulgation of performance standards applicable to the owners and operators of facilities for the treatment, storage, or disposal of hazardous waste.
- Section 3005: Requires the promulgation of regulations requiring each person owning or operating a treatment, storage, or disposal facility to obtain a permit.

These regulations establish a system for tracking the disposal of hazardous wastes and performance and design requirements for landfills accepting hazardous waste. Under RCRA, requirements are initially triggered by a determination that a waste is hazardous as defined in 40 CFR Part 261. Any party, including the original generator, that treats, stores, or disposes of a hazardous waste must notify EPA and obtain an EPA identification number. There are existing performance regulations governing the operation of hazardous waste landfills included in 40 CFR Parts 264 and 265. RCRA Subtitle C hazardous waste regulations apply to landfills that presently accept hazardous wastes or have accepted hazardous waste at any time after November 19, 1980.

3.1.1.1 Land Disposal Restrictions

The Hazardous and Solid Waste Amendments (HSWA) to the RCRA, enacted on November 8, 1984, largely prohibit the land disposal of untreated hazardous wastes. Once a hazardous waste is prohibited from land disposal, the statute provides only two options for legal land disposal: 1) meet the EPA-established treatment standard for the waste prior to land disposal, or 2) dispose of the waste in a land disposal unit that has been found to satisfy the statutory no migration test. A no migration unit is one from which there will be no migration of hazardous constituents for as long as the waste remains hazardous. (RCRA Sections 3004 (d),(e),(g)(5)).

Under Section 3004, the treatment standards that EPA develops may be expressed as either constituent concentration levels or as specific methods of treatment. Under RCRA Section 3004(m)(1), the criteria for these standards is that they must substantially diminish the toxicity of the waste or substantially reduce the likelihood of migration of hazardous constituents from the waste so that short-term and long-term threats to human health and the environment are minimized. For purposes of the restrictions, the RCRA program defines land disposal to include, among other things, any placement of hazardous waste in a landfill. Land disposal restrictions are published in 40 CFR Part 268.

EPA has used hazardous waste treatability data as the basis for land disposal restrictions standards. First, EPA has identified Best Demonstrated Available Treatment Technology (BDAT) for each listed hazardous waste. BDAT is the treatment technology that EPA finds to be the most effective in treating a waste and that also is readily available to generators and treaters. In some cases, EPA has designated as BDAT for a particular waste stream a treatment technology shown to have successfully treated a similar but more difficult to treat waste stream. This ensured that the land disposal restrictions standards for a listed waste stream were achievable since they always reflected the actual treatability of the waste itself or of a more refractory waste.

As part of the Land Disposal Restrictions (LDRs), Universal Treatment Standards (UTS) were promulgated as part of the RCRA phase two final rule (July 27,1994). The UTS are a series of concentrations for wastewaters and non-wastewaters that provide a single treatment standard for each constituent. Previously, the LDR regulated constituents according to the identity of the original waste; thus several numerical treatment standards existed for each constituent. The UTS simplified the standards by having only one treatment standard for each constituent in any waste residue. The LDR and the UTS restricted the concentrations of wastes that could be disposed of in landfills, thus improving the environmental quality of the leachate from landfills.

The LDR treatment standards established under RCRA may differ from the Clean Water Act effluent guidelines both in their format and in the numerical values set for each constituent. The differences result from the use of different legal criteria for developing the limits and resulting differences in the technical and economic criteria and data sets used for establishing the respective limits.

The differences in format of the LDR and effluent guidelines are that the LDR establish a single daily limit for each pollutant parameter whereas the effluent guidelines establish monthly and daily limits. Additionally, the effluent guidelines provide for several types of discharge, including new and existing sources, and indirect and direct discharge.

The differences in numerical limits established under the Clean Water Act may differ not only from LDR and UTS but also from point-source category to point-source category (e.g., Electroplating, 40 CFR 413; and Metal Finishing, 40 CFR 433). The effluent guidelines limitations and standards are industry-specific, subcategory-specific, and technology-based. The numerical limits are typically based on different data sets that reflect the performance of specific wastewater management and treatment practices. Differences in the limits reflect differences in the statutory factors that the Administrator is required to consider in developing technically and economically achievable limitations and standards: manufacturing products and processes (which for landfills involves types of waste disposed), raw materials, wastewater characteristics, treatability, facility size, geographic location, age of facility and equipment, non-water quality environmental impacts, and energy requirements. A consequence of these differing approaches is that similar or identical waste streams are regulated at different levels dependent on the receiving body of the wastewater (e.g. a POTW, a surface water, or a land disposal facility).

3.1.1.2 Minimum Technology Requirements

To further protect human health and the environment from the adverse affects of hazardous waste disposed of in landfills, the 1984 HSWA to RCRA established minimum technology requirements for landfills receiving hazardous waste. These provisions required the installation of double liners and leachate collection systems at new landfills, at replacements of existing units, and at lateral expansions of existing units. The Amendments also required all hazardous waste landfills to install groundwater monitoring wells by November 8, 1987. Performance regulations governing the operation of hazardous waste landfills are included 40 CFR Parts 264 and 265.

3.1.2 RCRA Subtitle D

Landfills managing non-hazardous wastes are currently regulated under the RCRA Subtitle D program. These landfills include municipal, private intra-company, private captive, and commercial facilities used for the management of municipal refuse, incinerator ash, sewage sludge, and a range of industrial wastes.

3.1.2.1 40 CFR Part 257, Subpart A Criteria

EPA promulgated these criteria on September 13, 1979 (44 FR 53460) under the authority of RCRA Sections 1008(a) and 4004(a) and Sections 405(d) and (e) of the Clean Water Act. These criteria apply to all solid waste disposal facilities and practices. However, certain facilities and practices are not covered by the criteria, such as agricultural wastes returned to the soil as fertilizers or soil conditioners; overburden resulting from mining operations; land application of domestic sewage or treated domestic sewage; hazardous waste disposal facilities which are subject to regulations under RCRA Subtitle C (discussed above); municipal solid waste landfills that are subject to the revised criteria in 40 CFR Part 258 (discussed below); and use or disposal of sewage sludge on the land when the sewage sludge is used or disposed of in accordance with 40 CFR Part 503 (See 40 CFR Part 257.1(c)(1) - (11)).

The criteria include general environmental performance standards addressing eight major areas: flood plains, protection of endangered species, protection of surface water, protection of groundwater, limitations on the land application of solid waste, periodic application of cover to prevent disease vectors, air quality standards (prohibition against open burning), and safety practices ensuring protection from explosive gases, fires, and bird hazards to airports. Facilities that fail to comply with any of these criteria are considered open dumps, which are prohibited by RCRA Section 4005. Those facilities that meet the criteria are considered sanitary landfills under RCRA Section 4004(a).

3.1.2.2 40 CFR Part 258 Revised Criteria for Municipal Solid Waste Landfills

On October 9, 1991, EPA promulgated revised criteria for municipal solid waste landfills in accordance with the authority provided in RCRA Sections 1008(a)(3), 4004(a), 4010 (c) and CWA Sections 405(d) and (e) (see 56 FR 50978). Under the terms of these revised criteria, municipal solid waste landfills are defined to mean a discrete area of land or an excavation that receives household waste, and is not a land application unit, surface impoundment, injection well, or waste pile, as those terms are defined in 40 CFR 257.2 and 258.2. In addition to household waste, a municipal solid waste landfill unit also may receive other types of RCRA Subtitle D wastes, such as commercial solid

waste, non-hazardous sludge, and industrial solid waste. Such a landfill may be publicly or privately owned. A municipal solid waste landfill unit may be a new unit, existing municipal solid waste landfill unit or a lateral expansion.

The municipal solid waste landfill revised criteria include location standards (Subpart B), operating criteria (Subpart C), design criteria (Subpart D), groundwater monitoring and corrective action (Subpart E), closure and post-closure care criteria (Subpart F), and financial assurance requirements (Subpart G). The design criteria provide that new municipal solid waste landfill units and lateral expansions of existing units (as defined in Section 258.2) must be constructed in accordance with either: (1) a design approved by a Director of a State whose municipal solid waste landfill permit program has been approved by EPA and which satisfies a performance standard to ensure that unacceptable levels of certain chemicals do not migrate beyond a specified distance from the landfill (Sections 258.40(a)(1), (c), (d), Table 1); or (2) a composite liner and a leachate collection system (Sections 258.40(a)(2), (b)). The groundwater monitoring criteria generally require owners or operators of municipal solid waste landfills to monitor groundwater for contaminants and generally implement a corrective action remedy when monitoring indicates that a groundwater protection standard has been exceeded. However, certain small municipal solid waste landfills located in arid or remote locations are exempt from both design and groundwater monitoring requirements. The closure standards require that a final cover be installed to minimize infiltration and erosion. The post-closure provisions generally require, among other things, that groundwater monitoring continue and that the leachate collection system be maintained and operated for 30 years after the municipal solid waste landfill is closed. The Director of an approved State may increase or decrease the length of the post-closure period.

Again, as is the case with solid waste disposal facilities that fail to meet the open dumping criteria in 40 CFR Part 257, Subpart A, municipal solid waste landfills that fail to satisfy the revised criteria in Part 258 constitute open dumps and are therefore prohibited by RCRA Section 4005 (40 CFR 258.1(h)). All solid waste disposal facilities (i.e., municipal solid waste landfills) that are subject to

the requirements in the Part 258 revised criteria and that collect and discharge landfill-generated waste waters are included in this category.

3.1.2.3 40 CFR Part 257, Subpart B Conditionally Exempt Small Quantity Generator Revised Criteria

A conditionally exempt small quantity generator is generally defined as one who generates no more than 100 kilograms of hazardous waste per month in a calendar year (40 CFR 261.5(a)). Such conditionally exempt small quantity generators (with certain exceptions) are not subject to RCRA Subtitle C requirements. However, on July 1, 1996, EPA: (1) amended Part 257 to establish criteria that must be met by non-municipal, non-hazardous solid waste disposal units that receive conditionally exempt small quantity generator waste; and (2) established separate management and disposal standards (in 40 CFR 261.5(f)(3) and (g)(3)) for those who generate conditionally exempt small quantity generator waste (see 61 FR 342169). The conditionally exempt small quantity generator revised criteria for such disposal units include location standards, groundwater monitoring, and corrective action requirements.

3.1.3 Current Wastewater Regulations

Prior to this regulatory initiative, EPA has not promulgated national effluent guidelines for the discharge of wastewaters from the landfills industry. In the absence of these guidelines, permit writers have had to rely on a combination of their own best professional judgement (BPJ), water quality standards, and technology transfer from other industrial guidelines in setting permit limitations for direct discharges from landfills to surface waters. In addition, municipalities also have had to rely on their own best professional judgement, pass-through analyses, and other local factors in establishing pretreatment standards for the discharge of wastewaters to their municipal sewage systems and POTWs.

In 1989, EPA completed a preliminary study of the Landfills industry. In a report entitled: "Preliminary Data Summary for the Hazardous Waste Treatment Industry," EPA concluded that wastewater discharges from landfills can be a significant source of toxic pollutants being discharged

to surface waters and POTWs. In a consent decree between NRDC and EPA, dated January 31, 1992, it was agreed that EPA would propose effluent limitations guidelines for the landfills point source category.

3.2 Industry Profile

The growth of the Landfills industry is a direct result of RCRA and subsequent EPA and State regulations that establish the conditions under which solid waste may be disposed. The adoption of increased control measures required by RCRA has had a number of ancillary effects.

The RCRA requirements have affected the Landfills industry in different ways. On the one hand, it has forced many landfills to close because they lacked adequate on-site controls to protect against migration of hazardous constituents in the landfill, and it was not economical to upgrade the landfill facility. As a result, a large number of landfills, especially facilities serving small populations, have closed rather than incur the significant expense of upgrading.

Conversely, large landfill operations have taken advantage of economies of scale to serve wide geographic areas and accept an increasing portion of the nation's solid waste. For example, responses to the EPA's Waste Treatment Industry Survey indicated that 75 percent of the nation's municipal solid waste was deposited in large landfills representing only 25 percent of the landfill population.

EPA has identified several trends in the waste disposal industry that may increase the quantity of leachate produced by landfills. More stringent RCRA regulation and the restrictions on the management of wastes have increased the amount of waste disposed at landfills with leachate collection systems as well as the number of facilities choosing to send their solid wastes off-site to commercial facilities in lieu of pursuing on-site management options. As a result of the increased disposal of solid wastes in landfills, the amount of leachate generated, collected, and discharged will increase, thus potentially putting at risk the integrity of the nation's waters.

3.2.1 Industry Population

The initial landfill population studied as part of EPA's survey of the industry was defined by a mailing list database developed by EPA from various sources such as State environmental and solid waste departments, the National Survey of Hazardous Waste Treatment, Storage, Disposal, and Recycling Facilities respondent list, Environmental Ltd.'s 1991 Directory of Industrial and Hazardous Waste Management Firms, and other sources discussed in Chapter 4. A total of 10,477 landfills (plus one pre-test facility) were identified as the initial landfill population in the United States in 1992, representing 9,882 Subtitle D non-hazardous landfills and 595 Subtitle C hazardous landfills, presented in Table 3-1 by state. A sampling of this initial population was solicited for technical information via screener surveys, and a sampling of the screener survey respondents were sent Detailed Questionnaires. A total of 252 landfill facilities received Detailed Questionnaires and 220 facilities responded with sufficient technical data to be included in the questionnaire database. A detailed discussion of screener survey and Detailed Questionnaire strata is presented in Chapter 4, Section 4.3.

Because Detailed Questionnaires were only sent to a sampling of the initial industry population, the information provided by questionnaire respondents needed to be scaled up to represent the entire Landfills industry. National estimates were calculated by matching up the screener survey stratum with the Detailed Questionnaire stratum. A weighting factor was calculated for each questionnaire respondent and any data provided by the respondent was scaled up by this factor. Therefore, all data presented throughout this chapter as national estimates are based on a combination of the Detailed Questionnaire respondents' data scaled up by their individual weighting factors. Figure 3-1 presents the logic used for the development of the national estimates. The methodology for calculating national estimates is presented in the Statistical Development Document for the Landfills industry.

3.2.2 Number and Location of Facilities

Many of the landfill facilities presented in Table 3-1 do not generate and/or collect wastewaters within the scope of this regulation. Landfill generated wastewaters evaluated for regulation in this guideline

include leachate, gas collection condensate, truck/equipment washwater, drained free liquids, laboratory-derived wastewater, floor washings, recovering pumping wells, and contaminated storm water. Contaminated groundwater and non-contaminated storm water are not proposed to be subject to the proposed regulation.

National estimates of the Landfills industry indicate that only 1,662 of the total population of landfill facilities collect in-scope wastewaters. EPA's survey of the industry was limited to those facilities that collect in-scope landfill generated wastewaters, or about 16 percent of the total number of landfills located in the U.S. Table 3-2 presents these Subtitle D and Subtitle C landfills that collect in-scope wastewater by ownership type. The national estimates for the industry indicate that approximately 43 percent of these landfills are municipally-owned facilities, 41 percent are commercially-owned, and 13 percent are non-commercial captives. Table 3-2 also shows that the majority of non-hazardous landfills are municipally- or commercially-owned facilities whereas hazardous landfills are primarily commercially-owned and captive facilities.

3.2.2.1 Captive Landfill Facilities

Based on EPA's survey of the Landfills industry for this guideline, over 200 captive and intra-company facilities with on-site landfills were identified. EPA has decided not to include within the scope of the guideline landfill facilities operated in conjunction with other industrial or commercial operations which only receive waste from off-site facilities under the same corporate structure (intra-company facility) and/or receive waste generated on-site (captive facility) so long as the wastewater is commingled for treatment with other process wastewaters.

A majority of these landfills were found at industrial facilities that are or will be subject to three effluent guidelines: Pulp and Paper (40 CFR Part 430), Centralized Waste Treatment (proposed 40 CFR Part 437, 60 FR 5464 January 27, 1995), or Organic Chemicals, Plastics and Synthetic Fibers (40 CFR Part 414). In addition, EPA identified approximately 30 landfills subject to one or more of the following categories: Nonferrous Metals Manufacturing (40 CFR Part 421), Petroleum Refining (40 CFR 419), Timber Products Processing (40 CFR Part 429), Iron and Steel Manufacturing (40

CFR Part 420), Transportation Equipment Cleaning (new category to be proposed in 1998), and Pesticide Manufacturing (40 CFR Part 455).

Industry supplied data estimates that there are over 118 Pulp and Paper facilities with on-site landfills and that over 90 percent commingle landfill leachate with process wastewater for treatment on-site. The wastewater flow originating from landfills typically represents less than one percent of the total flow through the facilities' wastewater treatment plant and in no case exceeds three percent of the treated flow. Approximately six percent of pulp and paper mills send landfill generated wastewater to a POTW along with process wastewater.

Based on responses to the 1992 Waste Treatment Industry: Landfills Questionnaire, EPA estimates that there are more than 30 facilities subject to the Organic Chemicals, Plastics and Synthetic Fibers (OCPSF) guideline with on-site landfills. At OCPSF facilities with on-site landfills, landfill leachate typically represents less than one percent of the industrial flow at the facility, in no case exceeds six percent of the flow, and is typically commingled with process wastewater for treatment.

3.2.3 General Information on Landfill Facilities

Landfill facilities located throughout the U.S. are estimated to cover approximately 726,000 acres of land area, 20 percent of which is used as actual disposal area (landfill), 3 percent is used for wastewater treatment operations, and 63 percent is undeveloped land. Table 3-3 presents national estimates of the total landfill area covered by non-hazardous and hazardous landfill facilities. National estimates indicate that hazardous facilities use less of their total facility area for waste disposal, only about 5 percent, compared to non-hazardous facilities which use approximately 30 percent of their total facility area for waste disposal. Table 3-4 presents facility land area ranges for non-hazardous and hazardous facilities as well as totals for the industry. These frequency distributions show that a typical facility is 100 to 1,000 acres in size, and the landfill covers between 10 and 100 acres of that area. The majority of non-hazardous and hazardous landfill facilities have from 10 acres to 1,000 acres of undeveloped land available; larger facilities may have as much as 1,000 to 10,000 acres of undeveloped land.

Landfills are made up of individual cells which may be dedicated to one type of waste or may accept many different types of waste. When a landfill cell reaches capacity volume, it is closed and is referred to as an "inactive" cell. Landfill cells that are not at capacity and continue to accept waste are considered to be "active" cells. Table 3-5 presents national estimates of the number of landfill cells, both active and inactive, at non-hazardous and hazardous landfills. National estimates of landfill facilities in the U.S. indicate that the average number of cells in a landfill is approximately six, with facilities averaging anywhere from 2.75 active cells to six inactive cells. For hazardous facilities, most landfills average 7.6 cells, with 4.2 active cells and 8.2 inactive cells. For non-hazardous facilities, landfills average 5.7 cells with 2.5 active cells and 5.4 inactive cells. The number of survey respondents was lower for "active" cells compared to "inactive" cells because these facilities reflect the number of landfills in the U.S. that are presently open or active. There are fewer active landfills in the U.S. than inactive, or closed landfills.

The number and type of customers served helps to define the size of a landfill. Table 3-6 presents the national estimates of the household and non-household population served by landfills that collect in-scope landfill wastewaters. The total population served by the Landfills industry is 46.3 million household and 5.2 million non-household customers. Non-hazardous landfills serve 99 percent of these customers. Hazardous landfills account for only 307,000 household customers and 170,000 non-household customers. Table 3-7 presents the frequency distributions of the number of household and non-household customers for the non-hazardous and hazardous subcategories as well as for both subcategories combined. Most non-hazardous facilities serve between 100 and 1,000 non-household customers and 10,000 to 100,000 household customers. Hazardous facilities serve all ranges of non-household customers, from zero to 10,000, but serve very few household customers.

3.2.4 Waste Receipts and Types

Wastes received by landfills in the United States vary from municipal solid waste to highly toxic materials. Table 3-8 presents the national estimates of the types of waste received at landfills and the percentage each waste represents of the total waste received during the following three periods: pre-1980; 1980-1985; and 1986-1992. The primary waste types landfilled during the pre-1980 time

period were municipal solid waste and industrial wastes, making up 61 percent of the waste, and commercial solid waste and construction and demolition debris making up 17 percent of the waste. Similar types of waste were landfilled after 1980; however, the percentage of municipal solid waste and industrial waste decreased, and the amount of commercial solid waste, incinerator residues, PCB/TSCA wastes, and asbestos-containing wastes increased. The landfilling of "other" waste types which include contaminated soils, auto shredder scrap, and tires, also increased after 1980.

Table 3-9 presents the national estimates of wastes received by the Landfills industry in 1992 by regulatory classification. These data indicate that landfills contained approximately 6.1 billion tons of waste in 1992, and project a future capacity of 8.3 billion tons. However, the estimated future capacity of Subtitle D landfills is much larger than the future capacity of Subtitle C landfills. On average, Subtitle D landfills represent almost 75 percent of the future capacity of U.S. landfills.

Table 3-10 presents the national estimates of the annual tonnage of waste accepted by landfills from 1988 through 1992. In 1988, the annual tonnage of waste accepted by Subtitle C and Subtitle D landfills was 221 million tons and by 1992, the amount of waste accepted annually increased by 94 million tons. The annual tonnage of waste accepted by the industry increased 17 percent from 1989 to 1990, and 12 percent from 1990 to 1991. However, Subtitle C landfills experienced the greatest increase and in annual waste accepted from 1989 to 1991; in 1990 the amount of waste increased 23 percent from 1989, and in 1991 the amount of waste increased 43 percent from 1990. Over the three year period,from 1989 to 1991, the annual tonnage of waste landfilled in Subtitle C landfills increased 56 percent. Conversely, the annual tonnage of waste accepted by Subtitle D landfills increased by only 4 percent from 1990 to 1991 and 1991 to 1992, down from a 15 percent increase in 1990. This increase in annual waste deposited in Subtitle C landfills may reflect the more strict enforcement of RCRA regulations regarding what types of waste can be deposited in a Subtitle D landfill (Subtitle C hazardous waste is now restricted from Subtitle D landfills and is disposed in Subtitle C landfills).

3.2.5 Sources of Wastewater

As noted earlier, wastewater is generated from a number of landfill operations. In general, the types of wastewater generated by activities associated with landfills and collected for treatment, discharge, or recycled back to the landfill are leachate, landfill gas condensate, truck/equipment washwater, drained free liquids, laboratory-derived wastewater, floor washings, recovering pumping wells, contaminated groundwater, and storm water. Table 3-11 presents the national estimates of the number of landfills that generate each type of wastewater and the minimum, maximum, and mean flows. Each of these wastewater sources are discussed below.

3.2.5.1 Landfill Leachate

Landfill leachate is a liquid that has passed through or emerged from solid waste and contains soluble, suspended, or miscible materials removed from such waste (40 CFR 258.2). Leachate typically is collected from a liner system above which waste is placed for disposal. Leachate also may be collected through the use of slurry walls, trenches or other containment systems. The leachate generated varies from site-to-site, based on a number of characteristics which include the types of waste accepted, operating practices including shedding, daily cover and capping, the depth of fill, compaction of wastes, and landfill age. Based on EPA's survey of the industry, a total of 1,989 landfill facilities generate wastewater at flows ranging from one gallon per day to 533,000 gallons per day, with a daily mean of approximately 13,600 gallons. Landfill leachate accounts for over 95 percent of in-scope wastewaters in the Landfills industry.

3.2.5.2 Landfill Gas Condensate

Landfill gas condensate is a liquid that has condensed in the landfill gas collection system during the extraction of gas from within the landfill. Gases such as methane and carbon dioxide are generated due to microbial activity within the landfill and must be removed to avoid hazardous conditions. In the gas collection systems, gases containing high concentrations of water vapor condense in traps staged throughout the gas collection network. The gas collection condensate contains volatile compounds and typically accounts for a small portion of flow from a landfill. The national estimates

presented on Table 3-11 report a total of 158 landfill facilities that generate landfill gas condensate at daily flows ranging from 3 gallons to 11,700 gallons. The mean flow of landfill gas condensate for the Landfills industry is approximately 510 gallons per day.

3.2.5.3 Truck and Equipment Washwater

Truck and equipment washwater is generated during either truck or equipment washes at landfills. During routine maintenance or repair operations, trucks and/or equipment used within the landfill (e.g., loaders, compactors, or dump trucks) are washed, and the resultant washwaters are collected for treatment. In addition, it is common practice in hazardous landfills to wash the wheels, body, and undercarriage of trucks used to deliver the waste to the open landfill face upon leaving the landfill. On-site wastewater treatment equipment and storage tanks also are periodically cleaned with their washwaters collected. It is estimated that 416 landfill facilities generate truck and equipment washwater at a mean flow of 786 gallons per day and at daily flows ranging from 5 gallons per day to 15,000 gallons per day.

Floor washings are also generated during routine cleaning and maintenance of landfill facilities. National estimates presented on Table 3-11 indicate there are 70 landfill facilities that generate and collect floor washings at flows ranging from 10 gallons per day to 5,450 gallons per day. The mean flow of floor washings for the Landfills industry is approximately 1,760 gallons per day.

3.2.5.4 Drained Free Liquids

Drained free liquids are aqueous wastes drained from waste containers (e.g., drums, trucks, etc.) or wastewater resulting from waste stabilization prior to landfilling. Landfills that accept containerized waste may generate this type of wastewater. Wastewaters generated from these waste processing activities are collected and usually combined with other landfill generated wastewaters for treatment. National estimates presented on Table 3-11 identify 33 landfill facilities that generate drained free liquids at a mean daily flow of 12,400 gallons. Daily flows range from a minimum of one gallon per day to a maximum of 82,000 gallons per day.

3.2.5.5 Laboratory-Derived Wastewater

Laboratory-derived wastewater is generated from on-site laboratories that characterize incoming waste streams and monitor on-site treatment performance. This source of wastewater is minimal and is usually combined with leachate and other wastewaters prior to treatment at the wastewater treatment plant.

3.2.5.6 Recovering Pumping Wells

In addition to the contaminated groundwater generated during groundwater pumping operations, there are various ancillary operations that also generate a wastewater stream. These operations include construction and development, well maintenance, and well sampling (i.e. purge water). These wastewaters will have very similar characteristics to the contaminated groundwater. EPA's survey of the Landfills industry identified 50 landfill facilities that generate wastewater from recovering pumping wells. Daily flows range from a minimum of 0.3 gallons to a maximum 80,167 gallons and a mean daily flow of 16,900 gallons.

3.2.5.7 Contaminated Groundwater

Contaminated groundwater is water below the land surface in the zone of saturation that has been contaminated by landfill leachate. Contamination of groundwater may occur at landfills without liners or at facilities that have released contaminants from a liner system into the surrounding groundwater and is collected and treated by landfills. Groundwater also can infiltrate the landfill or the leachate collection system if the water table is high enough to penetrate the landfill area. EPA identified approximately 163 landfill facilities that generate contaminated groundwater. Daily flows ranged from 6 gallons per day to 987,000 gallons per day, with a mean daily flow of approximately 48,000 gallons. Contaminated groundwater has been excluded from regulation under this guideline as discussed in Chapter 2 of this document.

3.2.5.8 Storm Water

There are two types of storm water, contaminated and non-contaminated. Contaminated storm water is runoff that comes in direct contact with the solid waste, waste handling and treatment areas, or wastewater flows that are covered under this rule. Non-contaminated (non-contact) storm water does not come in direct contact with solid waste, waste handling and treatment areas, or wastewater flows which are covered under this rule. National estimates indicate that there are 1,135 landfill facilities that generate storm water at flows ranging from 10 gallons per day to 2 million gallons per day, with a mean daily flow of approximately 66,200 gallons. Storm water that does not come into contact with the wastes would not be subject to the proposed limitations and standards.

3.2.6 Leachate Collection Systems

All facilities included in EPA's survey of the Landfills industry generate and collect landfill leachate. To prevent waste material, products of waste decomposition, and free moisture from traveling beyond the limits of the disposal site, landfill facilities utilize some type of leachate collection system. The purpose of the leachate collection system is to collect leachate for treatment or alternate disposal and to reduce the depths of leachate buildup or level of saturation over the liner.

The leachate collection system usually contains several individual components. Two main leachate collection systems may be necessary: an underdrain system and a peripheral system. The underdrain system is constructed prior to landfilling and consists of a drainage system that removes the leachate from the base of the fill. The peripheral system can be installed after landfilling has occurred and, as such, is commonly used as a remedial method. The underdrain system includes a drainage layer of high permeability granular material, drainage tiles to collect the diverted flow laterally toward them, and a low permeability liner underlying the system to retard the leachate that percolates vertically through the unsaturated zone of refuse. Where the leachate meets the low permeability layer, saturated depths of leachate develop and leachate flow is governed by hydraulic gradients within the drainage layer (see reference 8).

There are several different types of leachate collection systems employed by the Landfills industry to collect the wastewaters generated by landfill operations. Table 3-12 presents the different types of leachate collections systems and the national estimates of the number of facilities which employ each system. A simple gravity flow drain field is the most basic and commonly used type of collection system employed by 50 percent of the industry. Compound leachate collection systems, which are comprised of a liner system and collection pipes, were used by 20 percent of the industry and french drains, which are gravel channels used to facilitate leachate drainage, were used by 15 percent of landfill facilities in the U.S. Other types of leachate collection systems utilized by 10 percent of the Landfills industry include collection sumps and risers, combined gas/leachate extraction wells, perforated toe drains to pump stations, and gravity flow in pipes to a holding pond, basin, or pump station to storage tanks.

3.2.7 Pretreatment Methods

Several types of waste accepted by landfills for disposal may require some type of pretreatment. Wastes that may require pretreatment include free liquids, containerized waste, and bulk wastes. Free liquids may be drained or removed, or stabilized. Containerized waste and bulk wastes may be shredded, stabilized, or solidified. Table 3-13 presents the types of pretreatment methods currently in use by the Landfills industry and national estimates of the number of facilities that pretreat these wastes.

Approximately 75 percent of non-hazardous landfill facilities do not accept free liquids, and of those that do, 20 percent do not pretreat the liquids before treatment at an on-site wastewater treatment facility or treatment off-site. In comparison, approximately 65 percent of hazardous landfill facilities accept free liquids and pretreat by stabilizing, draining or removing the liquid. Containerized waste is accepted by only 40 percent of non-hazardous landfill facilities, but is accepted by almost 75 percent of hazardous landfill facilities. The most common type of pretreatment for containerized waste is solidification followed by stabilization. Bulk wastes are accepted by most landfills, although many facilities do not pretreat this type of waste. Bulk wastes are usually treated by stabilization or

solidification and stabilization; however, other types of pretreatment include compaction, chemical treatment, flocculation, macro/microencapsulation, and recycling.

3.2.8 Baseline Treatment

Many landfills in the United States currently have wastewater treatment systems in place. The most common treatment system used by landfills is biological treatment. However, chemical precipitation and combinations of biological treatment, chemical precipitation, equalization, and filtration also are used widely. Table 3-14, as well as Table 8-1, presents the types of treatment and the national estimates of the number of facilities that employ each type of wastewater treatment. As expected, indirect and zero dischargers often do not employ on-site treatment because they either ship their wastewaters off-site or use alternate disposal methods such as deep well injection, incineration, evaporation, land application, or recirculation. A detailed discussion of treatment technology and performance is presented in Chapter 8.

EPA's survey of the Landfills industry solicited wastewater treatment facility operating information from non-hazardous and hazardous landfills. Table 3-15 presents the national estimates of the number of landfill facilities that operate wastewater treatment systems between 1 and 24 hours per day. Direct and zero or alternative discharge facilities tend to operate treatment systems continuously, whereas many indirect discharge facilities operate less than 24 hours per day. Table 3-16 presents the average daily hours of operation of a typical on-site wastewater treatment facility. Table 3-17 presents the national estimates of the number of landfill facilities that operate wastewater treatment systems between 1 and 7 days per week. Again, direct and zero or alternative discharge facilities commonly operate their treatment systems continuously, whereas indirect dischargers do not. Table 3-18 presents the average number of days per week a typical wastewater treatment facility is in operation.

3.2.9 Discharge Types

Landfill facilities surveyed by the EPA are often grouped by discharge types. Direct discharge facilities are those that discharge their wastewaters directly to a receiving stream or body of water. Indirect discharging facilities discharge their wastewater indirectly to a POTW. Zero or alternative discharge facilities use treatment and disposal practices that result in no discharge of wastewater to surface waters. Zero or alternative disposal options for landfill generated wastewater include off-site treatment at another landfill wastewater treatment system or a Centralized Waste Treatment facility, deep well injection, incineration, evaporation, land application, solidification, and recirculation.

Table 3-19 presents the national estimates of the number of landfill facilities grouped by discharge type. These estimates show that the majority of non-hazardous facilities included in the survey were indirect dischargers, whereas the majority of hazardous facilities were mainly direct and zero dischargers.

Table 3-1: Number of Landfills per U.S. State

State	Subtitle D Landfills	Subtitle C Landfills	Total Landfills
Alabama	238	38	276
Alaska	201	1	202
Arizona	90	2	92
Arkansas	134	3	137
California	630	16	646
Colorado	216	12	228
Connecticut	125	22	147
Delaware	8	14	22
Florida	91	9	100
Georgia	277	17	294
Hawaii	15	1	16
Idaho	112	6	118
Illinois	182	14	196
Indiana	101	29	130
Iowa	118	13	131
Kansas	118	8	126
Kentucky	121	33	154
Louisiana	73	17	90
Maine	291	2	293
Maryland	50	5	55
Massachusetts	722	1	723
Michigan	762	9	771
Minnesota	257	4	261
Mississippi	97	3	100
Missouri	128	7	135
Montana	257	1	258
Nebraska	41	8	49
Nevada	127	3	130
New Hampshire	58	0	58
New Jersey	467	8	475
New Mexico	121	7	128
New York	565	10	575
North Carolina	244	39	283
North Dakota	85	1	86
Ohio	119	24	143
Oklahoma	189	7	196
Oregon	231	10	241
Pennsylvania	41	22	63
Rhode Island	12	0	12
South Carolina	127	9	136
South Dakota	193	0	193
Tennessee	112	9	121
Texas	601	70	671
Utah	92	7	99
Vermont	73	0	73
Virginia	440	8	448
Washington	72	9	81
West Virginia	57	5	62
Wisconsin	183	3	186
Wyoming	218	45	263
Puerto Rico	0	3	3
Guam	0	1	1
Total	9,882	595	10,477

Table 3-2: Ownership Status of Landfill Facilities

Ownership Status	Number of Facilities		
	Subtitle D Non-Hazardous Subcategory	Subtitle C Hazardous Subcategory	Industry Total
Commercial	506	171	677
Non-Commercial (intra-company)	5	48	53
Non-Commercial (captive)	121	94	215
Municipal	708	2	710
Federal Government	4	2	6
Government (other than Federal or Municipal)	0	0	0
Indian Tribal Interest	0	0	0
Other	1	0	1
Total	1,345	317	1,662

Table 3-3: Total Landfill Facility Area

Facility Land Type	Landfill Facility Area (acres)		
	Subtitle D Non-Hazardous Subcategory	Subtitle C Hazardous Subcategory	Industry Total
Total Facility Area	416,733	309,194	725,927
Wastewater Treatment Area	9,424	10,147	19,571
Waste Disposal Area (landfill)	119,700	16,552	136,323
Undeveloped Land	254,610	207,085	459,811

Table 3-4: Landfill Facility Land Area Ranges

Subcategory	Land Area Range (acres)	Number of Landfill Facilities			
		Total Facility Area	Wastewater Treatment Area	Waste Disposal Area (landfill)	Undeveloped Land
All Facilities	0	0	747	28	110
	>0-1	0	320	16	2
	>1-10	9	437	126	69
	>10-100	490	136	1,128	561
	>100-1,000	1,044	22	362	745
	>1,000-10,000	119	0	0	85
	Total	1,662	1,662	1,660	1,662
Subtitle C Hazardous	0	0	38	5	49
	>0-1	0	128	14	0
	>1-10	2	70	47	2
	>10-100	95	65	199	99
	>100-1,000	136	15	52	106
	>1,000-10,000	84	0	0	60
	Total	317	316	317	316
Subtitle D Non-Hazardous	0	0	708	23	61
	>0-1	0	191	2	2
	>1-10	7	366	79	67
	>10-100	395	72	930	551
	>100-1,000	909	7	310	638
	>1,000-10,000	34	0	0	25
	Total	1,345	1,344	1,344	1,344

Table 3-5: Number of Landfill Cells

Subcategory	Type of Landfill Cell	Number of Cells	
		Estimated Mean	Estimated Total
All Facilities	Total cells	6.12	13,299
	Active cells	2.75	4,608
	Inactive cells	6.05	8,690
Subtitle C Hazardous	Total cells	7.64	3,776
	Active cells	4.23	1,112
	Inactive cells	8.24	2,663
Subtitle D Non-Hazardous	Total cells	5.68	9,523
	Active cells	2.48	3,496
	Inactive cells	5.41	6,027

Table 3-6: Household and Non-Household Population Served

Population Served	Number of Customers		
	Subtitle D Non-Hazardous Subcategory	Subtitle C Hazardous Subcategory	Industry Total
Non-Household	5,043,542	170,420	5,213,962
Household	46,007,775	307,243	46,315,018

Table 3-7: Household vs. Non-Household Customers

Number of Non-Household Customers	Number of Facilities		
	Subtitle D Non-Hazardous Subcategory	Subtitle C Hazardous Subcategory	Industry Total
0	76	123	205
1	83	40	124
>1-10	33	12	45
>10-100	202	4	203
>100-1,000	544	87	628
>1,000-10,000	351	51	400
>10,000-100,000	55	0	54
>100,000-1,00,000	2	0	2
Total	1,346	317	1,661
Number of Household Customers			
0	180	313	506
1	0	0	0
>1-10	55	0	55
>10-100	29	0	28
>100-1,000	42	0	42
>1,000-10,000	195	2	195
>10,000-100,000	742	0	733
>100,000-1,00,000	102	2	103
Total	1,345	317	1,662

Table 3-8: Wastes Received by Landfills in the United States

Waste Type	Mean % for Time Period Pre-1980	Mean % for Time Period 1980-85	Mean % for Time Period 1986-92
Municipal Solid Waste	38.3	33.4	33.9
Household Hazardous Waste	0.217	0.218	0.215
Yard Waste	4.76	4.39	3.76
Commercial Solid Waste	8.56	9.92	9.94
Institutional Wastes	1.36	1.43	2.14
Industrial Wastes	22.8	19.6	17.4
Agricultural Waste	0.340	0.297	0.284
Pesticides	0.033	0.009	0.321
PCB, TSCA Wastes	0.192	1.12	0.980
Asbestos-Containing Waste	0.905	3.73	3.42
Radioactive Waste	0.019	0.002	0.001
Medical or Pathogenic Waste	0.255	0.182	0.123
Superfund Clean-Up Wastes	0.000	0.021	0.014
Mining Wastes	0.519	0.47	0.180
Incinerator Residues	1.01	1.43	3.14
Fly Ash, Not Incinerator Waste	4.49	5.82	6.30
Construction/Demolition Debris	8.40	5.91	7.95
Sewage Sludge	1.81	3.15	2.88
Dioxin Waste	0.000	0.039	0.024
Other Sludge	4.89	4.90	2.91
Other Waste Types	1.23	4.49	5.25
Industry Total	100.09	100.528	101.132

Table 3-9: Total Volume of Waste Received by Landfills in 1992 by Regulatory Classification

Time Frame	Regulatory Class	All Facilities		Subtitle C Hazardous Subcategory		Subtitle D Non-Hazardous Subcategory	
		Estimated Total Number Landfills	Total Volume Landfilled (tons)	Estimated Total Number Landfills	Total Volume Landfilled (tons)	Estimated Total Number Landfills	Total Volume Landfilled (tons)
Current	Pre 1980	561	954,273,421	190	155,418,921	370	798,854,500
	RCRA Subtitle C	333	159,252,888	323	158,994,443	10	258,445
	RCRA Subtitle D	906	1,501,319,521	115	249,656,514	791	1,251,663,007
	TSCA	108	53,167,884	102	52,654,468	6	513,416
	NRC	.	.	.	.	.	.
	Local Regulation	461	2,365,983,720	57	6,374,393	404	2,359,609,326
	CERCLA	4	10,507,627	2	72,587	2	10,435,040
	Other Regulation	560	1,018,656,724	114	36,250,349	446	982,406,374
	Total Volume Landfilled	2,146	6,063,161,789	491	659,421,679	1,655	5,403,740,110
			Future Capacity (tons)		Future Capacity (tons)		Future Capacity (tons)
Future	Pre 1980	86	101,032,485	.	.	86	101,032,485
	RCRA Subtitle C	201	66,313,422	193	65,192,737	8	1,120,685
	RCRA Subtitle D	884	6,056,763,187	33	96,321,683	851	5,960,441,504
	TSCA	34	11,202,929	28	10,897,045	6	305,884
	NRC	2	300,860	.	.	2	300,860
	Local Regulation	293	962,479,373	57	4,710,196	236	957,769,177
	CERCLA	50	4,297,618	50	4,297,618	.	.
	Other Regulation	501	1,126,823,595	127	30,749,439	374	1,096,074,156
	Total Volume Landfilled	1,706	8,329,213,474	266	212,168,721	1,441	8,117,044,753

Table 3-10: Annual Tonnage of Waste Accepted by Landfills

Year	Annual Tonnage of Waste (tons)		
	Subtitle D Non-Hazardous Subcategory	Subtitle C Hazardous Subcategory	Industry Total
1988	185,184,608	36,305,235	221,489,843
1989	196,377,576	28,867,681	225,245,257
1990	232,535,432	37,413,692	269,949,125
1991	241,454,300	65,402,768	306,857,068
1992	252,101,069	63,022,850	315,123,919

Table 3-11: Wastewater Flows Generated by Individual Landfills

Type of Wastewater Generated	Number of Landfills	Minimum Average Flow (gal/day)	Maximum Average Flow (gal/day)	Industry Mean (gal/day)
Floor washing	70	10	5,450	1,760
Landfill leachate	1,989	1	533,000	13,600
Contaminated groundwater	163	6	987,320	47,900
Storm water run-off	1,135	10	2,066,600	66,200
Landfill gas condensate	158	3	11,732	510
Recovering pumping wells	50	0.3	80,167	16,900
Truck/equipment washwater	416	5	15,000	786
Drained free liquids	33	1	82,000	12,400
Other	2	0	0	0
Total	4,016			

Table 3-12: Type of Leachate Collection Systems Used at Individual Landfills

Type of Leachate Collection	Number of Landfills		
	Subtitle D Non-Hazardous Subcategory	Subtitle C Hazardous Subcategory	Industry Total
None	46	87	132
Simple Gravity Flow Drain Field	977	266	1,242
French Drain System	341	38	379
Compound Leachate Collection	416	93	509
Suction Lysimeters	.	2	2
Other	196	49	246
Total	1,976	535	2,510

Table 3-13: Pretreatment Methods in Use at Individual Landfills

Type of Waste	Pretreatment Method	Number of Landfills		
		Subtitle D Non-Hazardous Subcategory	Subtitle C Hazardous Subcategory	Industry Total
Free Liquids	No Pretreatment	324	113	437
	None Accepted	1,277	283	1,560
	Drained or Removed	51	115	166
	Stabilization	38	172	211
	Other	17	84	101
	Total	1,707	767	2,475
Containerized Waste	No Pretreatment	515	100	616
	None Accepted	1,008	180	1,188
	Shredded	23	70	94
	Stabilized	6	135	141
	Solidified	41	138	179
	Other	110	80	190
	Total	1,703	703	2,408
Bulk Wastes	No Pretreatment	993	216	1,209
	None Accepted	414	61	475
	Baled	33	2	35
	Shredded	82	49	131
	Stabilized	15	201	216
	Solidified	74	126	200
	Other	100	38	138
	Total	1,711	693	2,404

Table 3-14: Types of Wastewater Treatment Employed by the Landfills Industry

Type of Treatment	Number of Landfills		
	Direct Discharge	Indirect Discharge	Zero Discharge
No treatment	84	689	468
Biological treatment	119	37	19
Chemical precipitation	63	45	8
Chemcial precipitation and biological treatment	32	10	0
Filtration and biological treatment	45	4	5
Equalization and biological treatment	65	28	7
Equalization, biological treatment, and filtration	37	4	5
Equalization, chemcial precipitation, and biological treatment	26	8	0
Equalization, chemcial precipitation, biological treatment, and filtration	26	2	0

Table 3-15: Wastewater Treatment Facility Hours of Operation per Day

Hours of Operation (hours/day)	Subtitle D Non-Hazardous Subcategory			Subtitle C Hazardous Subcategory			Industry Total		
	Direct	Indirect	Zero	Direct	Indirect	Zero	Direct	Indirect	Zero
0	0	0	0	0	0	0	0	0	0
1-23	11	299	40	11	4	6	23	277	42
24	165	500	330	122	20	153	286	545	488
Total	176	799	370	133	24	159	309	822	530

Table 3-16: Wastewater Treatment Facility Average Hours of Operation per Day

Subcategory	Average Hours of Operation/Day		
	Direct Discharge	Indirect Discharge	Zero Discharge
All Facilities	22.81	19.10	22.55
Subtitle C Hazardous	22.78	22.18	23.46
Subtitle D Non-Hazardous	22.86	18.42	21.89

Table 3-17: Wastewater Treatment Facility Days of Operation per Week

Days of Operation (days/week)	Subtitle D Non-Hazardous Subcategory			Subtitle C Hazardous Subcategory			Industry Total		
	Direct	Indirect	Zero	Direct	Indirect	Zero	Direct	Indirect	Zero
0	0	0	0	0	0	0	0	0	0
1-6	7	228	40	19	2	6	31	205	42
7	168	571	330	115	22	153	279	618	488
Total	175	799	370	134	24	159	310	823	530

Table 3-18: Wastewater Treatment Facility Average Days of Operation per Week

Subcategory	Average Days of Operation/Week		
	Direct Discharge	Indirect Discharge	Zero Discharge
All Facilities	6.73	6.46	6.81
Subtitle C Hazardous	6.56	6.83	6.77
Subtitle D Non-Hazardous	6.94	6.38	6.84

Table 3-19: Total Number of Facilities by Discharge Type

Subcategory	Discharge Type			Total
	Direct	Indirect	Zero	
All Facilities	310	823	529	1,662
Subtitle C Hazardous	134	24	159	317
Subtitle D Non-Hazardous	176	799	370	1,345

Figure 3-1: Development of National Estimates for the Landfills Industry